

METHOD OF TRANSMISSION FROM TCP/IP COMMUNICATION NETWORK
TO MOBILE COMMUNICATION NETWORK AND TRANSMISSION AND
RECEPTION SYSTEM THEREFOR

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BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to communication
between a mobile communication network for a personal
digital cellular telecommunication system (PDC) etc. and
a TCP/IP (Transmission Control Protocol/Internet
Protocol) communication network and, more particularly,
to a method of transmission from a TCP/IP communication
network to a mobile communication network for conducting
transmission from a TCP/IP communication network to a
mobile communication terminal accommodated in a mobile
communication network for a personal digital cellular
telecommunication system etc. (reception at the mobile
communication terminal side) and a transmission and
reception system therefor.

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DESCRIPTION OF THE RELATED ART

Conventionally proposed is a technique of
transferring data from a terminal (personal computer)
and the like accommodated in a TCP/IP communication
network (intranet, Internet, extranet) to a non-TCP/IP
communication network, for example, the mobile
communication terminal accommodated in a mobile

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communication network for a personal digital cellular telecommunication system (PDC) (e.g. "Method and System for Enabling Mobile Station to Participate in Data Communication" recited in Japanese Patent Laying-Open (Kokai) No. Heisei 11-27290).

Such a mobile communication terminal in a personal digital cellular telecommunication system conducts communication with a TCP/IP communication network through this mobile communication network. In this case, transmission from a mobile communication terminal to an Internet service provider is possible, while transmission using an IP packet from an Internet user (a terminal accommodated in the TCP/IP communication network) to a mobile communication terminal through an Internet service provider (reception at the mobile communication terminal side) is not possible in some cases.

Fig. 5 is a block diagram showing a structure of a conventional mobile communication system and Fig. 6 is a block diagram showing a structure of main components of a provider connection interworking function device for establishing Internet connection in the conventional mobile communication system. Fig. 7 is a diagram showing a sequence at the time of Internet connection in the conventional mobile communication system (transmission from a mobile communication terminal).

In Fig. 5, a data terminal (DTE) 1 such as a

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path. The data terminal 1 sends an Internet
protocol/transmission control protocol/synchronizing
signal (IP+TCP(SYN)) to an access server (ACC-SER) 7 in
an Internet service provider (ISP) 8. The access server
5 7 sends out the Internet protocol/transmission control
protocol/synchronizing signal (IP+TCP (SYN)) to an
Internet 9. Thereafter, between the data terminal 1 and
a terminal not shown which is accommodated in the
Internet 9, HTML data transmission etc. is conducted by
10 TCP/IP link open.

In Fig. 6, at the provider connection
interworking function device 6b, terminating processing
circuits (ARQ-RX and ARQ-TX) 10a and 10b conduct
terminating processing of an error control protocol on
15 the side of a radio line. Asynchronous terminating
processing circuits (ASync-RX and ASync-TX) 11a and 11b
conduct terminating processing with respect to
communication over a serial asynchronous line with the
access server 7 on the side of the Internet service
20 provider 8.

In this operation, the calling processing device
6c of the mobile communication switching system 6
controls the time-division switch 6a to set a user data
transfer channel and a control channel with the radio
25 base station control device 5. Also, an approach link is
set between the radio base station (BTS) 4 and the radio
base station control device (BSC) 5.

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As described in the foregoing, the above conventional art fails to enable an Internet user (terminal) to conduct transmission using an IP packet to a mobile communication terminal (reception at the mobile communication terminal side) through an Internet service provider, which accordingly makes, for example, HTML data transmission impossible and causes inconvenience in use.

SUMMARY OF THE INVENTION

An object of the present invention is to solve such problems of conventional art as mentioned above and provide a method of conducting transmission from a TCP/IP communication network to a mobile communication network which allows a relatively simple structure to realize transmission using an IP packet to a mobile communication terminal accommodated in a mobile communication network for a personal digital cellular telecommunication system etc. from a terminal accommodated in a TCP/IP communication network (reception at the mobile communication terminal side) while allowing facility in use to be improved, and a transmission and reception system therefor.

Another object of the present invention is to provide a method of conducting transmission from a TCP/IP communication network to a mobile communication network which allows a user of the TCP/IP communication

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a provider connection interworking function
device for extracting an IP address of the mobile

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an asynchronous terminating processing circuit
for conducting terminating processing with respect to
communication on a serial asynchronous line with the
provider access server for TCP/IP communication network

line connection,

a synchronous pattern detection circuit for detecting a synchronous pattern to determine first arrival of an IP packet transferred through the asynchronous terminating processing circuit,

an IP address/telephone number converting circuit for searching for a user's telephone number corresponding to an IP address of the mobile communication terminal as a transmission destination which is stored in a header of an IP packet from the synchronous pattern detection circuit, and

a transmission signal sending circuit for sending out an originating signal and a selection signal to the mobile communication switching system based on a user's telephone number from the IP address/telephone number converting circuit.

In another preferred construction, the IP address/telephone number converting circuit includes

an IP address/telephone number conversion table which stores a user's telephone number corresponding to an IP address.

In another preferred construction, the mobile communication network is

a mobile communication network in a personal digital cellular telecommunication system (PDC).

In another preferred construction, the mobile communication network is

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a mobile communication network to which the PIAFS standard in the personal handy phone system (PHS) is applied.

In another preferred construction, an IP address and a user's telephone number in the IP address/telephone number conversion table are

set by a manager of the mobile communication network accommodating the mobile communication switching system.

In another preferred construction, an IP address and a user's telephone number in the IP address/telephone number conversion table are

set through a terminal accommodated in the TCP/IP communication network by the execution of a communication control protocol for the IP address/telephone number conversion table of the IP address/telephone number converting circuit.

In another preferred construction, the provider access server and the mobile communication switching system

conduct switching connection for the transmission from the mobile communication terminal accommodated in the mobile communication network to the TCP/IP communication network.

In another preferred construction, the TCP/IP mobile communication network transmission and reception system further comprises

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In the preferred construction, the mobile

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a mobile communication network in a personal digital cellular telecommunication system (PDC).

In another preferred construction, the mobile communication network is

a mobile communication network to which the PIAFS standard in the personal handy phone system (PHS) is applied.

In another preferred construction, switching connection for the transmission from the mobile communication terminal accommodated in the mobile communication network to the TCP/IP communication network is conducted.

Other objects, features and advantages of the present invention will become clear from the detailed description given herebelow.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given herebelow and from the accompanying drawings of the preferred embodiment of the invention, which, however, should not be taken to be limitative to the invention, but are for explanation and understanding only.

In the drawings:

Fig. 1 is a block diagram showing a structure for use in an embodiment of the present invention

Fig. 2 is a block diagram showing a structure of main components of a provider connection interworking function device illustrated in Fig. 1;

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Fig. 6 is a block diagram showing a functional structure of a provider connection interworking function device for Internet connection in the conventional mobile communication system;

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The preferred embodiment of the present invention will be discussed hereinafter in detail with reference to the accompanying drawings. In the following

description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be obvious, however, to those skilled in the art that the present invention may be practiced
5 without these specific details. In other instance, well-known structures are not shown in detail in order to unnecessary obscure the present invention.

Detailed description will be made of an embodiment of the present invention implementing a
10 method of conducting transmission from a TCP/IP communication network to a mobile communication network and a transmission and reception system therefor with reference to the drawings.

In the drawings and description set forth below,
15 the same components as those in Fig. 5 are allotted the same reference numerals.

Fig. 1 is a block diagram showing a structure for use in an embodiment of the present invention implementing a method of conducting transmission from a
20 TCP/IP communication network to a mobile communication network and a transmission and reception system therefor.

In Fig. 1, the present example includes a data terminal (DTE) 1 such as a general-purpose small-sized computer (PC), a data communication adapter (MS-ADP) 2
25 such as a modulator and demodulator (MODEM) for enabling the data terminal 1 to conduct transmission and reception to and from a mobile communication network,

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and a mobile communication terminal 3 (MS) such as a portable telephone or a mobile data terminal. These are components for accessing an Internet 9 for a Web page by HTML data transmission through the mobile communication terminal 3 (portable telephone), for transmitting and receiving an electronic mail and for making an Internet telephone which will be described later.

This structure also includes a radio base station (BTS) 4 which will be connected through a line to the mobile communication terminal 3 in a radio zone within a service area (cell), a radio base station control device (BSC) 5 which accommodates the radio base station 4, and a mobile communication switching system (MSC) 6A which will connect to the radio base station control device 5 based on a common channel signaling system etc. to establish switching connection with a radio communication network (PDC/PHS) and a wired communication network (ISDN/PSTN).

This example further includes a time-division switch (TDNW) 6-1 for processing time-division with respect to line switching connection, a calling processing device (CP) 6-3 for executing calling control processing with respect to the mobile communication terminal 3 and a provider connection interworking function device (PRV-IWF) 6-2 for the connection with a provider (an access server/asynchronous serial-LAN protocol converter 7 and an Internet service provider 8

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which will be described later), all of which components are provided in the mobile communication switching system 6A.

The example also includes an originating signal detection circuit (LC) 6-4 for detecting an originating signal (e.g. loop signal) from the provider connection interworking function device 6-2 and a selection signal reception circuit (DPREC) 6-5 for receiving a selection signal (a dial pulse string and a dual tone/push button (PB) signal) from the provider connection interworking function device 6-2 which signal is received through the originating signal detection circuit 6-4.

In addition, the example includes the access server (ACC-SER/asynchronous serial-LAN protocol converter) 7 as a provider access server for sending out an IP packet, the Internet service provider (ISP) 8 and the Internet 9.

Fig. 2 is a block diagram showing a structure of main components of the provider connection interworking function device 6-2. The provider connection interworking function device 6-2 includes terminating processing circuits (ARQ-RX and ARQ-TX) 10a and 10b for conducting terminating processing of an error control protocol on the side of the radio line, asynchronous terminating processing circuits (ASYNC-RX and ASYNC-TX) 11a and 11b for conducting terminating processing with respect to communication on a serial asynchronous line

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with the access server 7 on the side of the Internet service provider (ISP) 8, and an SYN pattern detection circuit (SYN-DET) 10d for detecting an SYN (synchronizing signal) pattern in an IP packet sent from the access server 7 on the side of the Internet service provider 8.

The provider connection interworking function device 6-2 also includes an IP address/telephone number converting circuit (IP/Tel. No. CONV) 10e having an IP address/telephone number conversion table (see Fig. 4) for converting an IP address into a telephone number and a transmission signal sending circuit (Tel. Circuit) 10f for sending an off-hook signal (originating signal/loop signal) and a dial signal (selection signal) to the mobile communication switching system 6A.

Next, operation of the present embodiment will be described.

First, operation of calling from the mobile communication terminal (MS) 3 to the Internet 9 (sequence) will be described in brief. The calling operation (sequence) is the same as that of the above-described conventional example illustrated in Fig. 7.

The mobile communication terminal 3, which is connected to the data terminal 1 through the data communication adapter 2, connects to the radio base station 4 in a radio zone (radio line). The radio base station control device 5 which accommodates numerous

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radio base stations 4 is connected to the mobile communication switching system 6A through a line. Through the line connection with the mobile communication switching system 6A, the mobile communication terminal 3 conducts transmission to a radio communication network (PDC/PHS) or a wired communication network (ISDN/PSTN) and responds to reception.

When the mobile communication terminal 3 accesses the Internet 9, its line connection with the provider connection interworking function device 6-2 provided in the mobile communication switching system 6A is established through the above-described line connection with the mobile communication switching system 6A. The mobile communication switching system 6A is connected to the provider connection interworking function device 6-2 and the access server 7 (Internet service provider 8) to process the interface with the Internet 9.

Furthermore, the provider connection interworking function device 6-2 and the access server 7 are connected to each other through a line, so that the terminal 3 accesses the Internet 9 through the Internet service provider 8 to conduct HTML data transmission. For example, a Web page is accessed, or an electronic mail transmitted by the data terminal 1 is sent to an IP address destination of the Internet 9 (a Web page device accommodated in a terminal/Internet and a small-sized

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In such access operation from the mobile communication terminal 3 to the Internet 9, the time-division switch 6-1 in the mobile communication switching system 6A sets a user data transfer channel and a control channel and conducts time-division processing, the calling processing device 6-3 executes calling processing control with respect to the mobile communication terminal 3 and furthermore, the provider connection interworking function device 6-2 establishes line connection with a provider (access server 7 and the Internet service provider 8).

Next, description will be made of operation of conducting transmission from the Internet 9 to the mobile communication terminal 3.

~~4~~ Fig. 3 is a sequence diagram showing processing

at the transmission from the Internet 9 to the mobile communication terminal 3, and Fig. 4 is a diagram for use in explaining the contents of an IP address/telephone number conversion table in the IP address/telephone number converting circuit 10e illustrated in Fig. 2.

In order to conduct transmission to the mobile communication terminal 3 from a terminal or the like accommodated in the Internet 9, set in advance at the IP address/telephone number conversion table in the IP address/telephone number converting circuit 10e as shown in Fig. 4 are user's telephone numbers (090-****-XXX 0~7) of numbers of mobile communication terminals 3 as transmission targets which are made one-to-one corresponding to IP addresses (ala2a3 blb2b3 clc2c3 dld2 0~7).

In order to conduct transmission to the desired mobile communication terminal 3 from a terminal accommodated in the Internet 9, connect to an access point in the Internet 9 to transmit an IP address in the IP address/telephone number conversion table shown in Fig. 4. The IP address is transferred to the access server 7 on the side of the Internet service provider 8 as the Internet protocol/transmission control protocol/synchronizing signal IP+TCP(SYN) shown in Fig. 3 and further transferred to the provider connection interworking function device 6-2.

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result, the data communication adapter 2, the mobile communication terminal 3, the radio base station 4, the radio base station control device 5 and the mobile communication switching system 6A (calling processing device 6-3, time-division switch 6-1) are sequentially connected through a line by setup. The mobile communication switching system 6A sends out a seizing signal/(SEZ) to the provider connection interworking function device 6-2.

The provider connection interworking function device 6-2 returns an acknowledge (ACK) in response to the seizing signal (SEZ) to the mobile communication switching system 6A through the data communication adapter 2, the mobile communication terminal 3, the radio base station 4 and the radio base station control device 5. The mobile communication switching system 6A sets a radio-side path. The data communication adapter 2 and the provider connection interworking function device 6-2 set an automatic retransmission request (ARQ).

The provider connection interworking function device 6-2 returns an answer (ANS) to the mobile communication switching system 6A. The mobile communication switching system 6A sets a network-side path. The data terminal 1 sends out the IP address and the Internet protocol/transmission control protocol/synchronizing signal (IP+TCP(SYN)) to the access server 7, which are further transferred to the

Internet 9 through the Internet service provider 8.
Thereafter, by TCP/IP link open between the data
terminal 1 and the Internet 9, HTML data transmission is
conducted between a terminal accommodated in the
5 Internet 9 and the data terminal 1.

This HTML data transmission, in which data is
transmitted in an IP packet in TCP/IP communication,
will enable the data terminal 1 to transmit and receive
an electronic mail to and from a terminal of the
10 Internet 9. Also enabled is communication over a
telephone. Telephone communication is realized with
software such as "Internet Phone" and "Net Meeting"
installed in the data terminal 1 and a terminal
accommodated in the Internet 9 together with a Web
15 browser and a transmitter/receiver (microphone/speaker
etc.)

Thus, in the present embodiment, an SYN pattern
is detected to find out the first arrival of an IP
packet. As a result, calling to the mobile communication
switching system 6A is allowed to enable transmission
20 from a terminal accommodated in the Internet 9 to the
mobile communication terminal 3 (reception at the mobile
communication terminal 3).

Moreover, only by adding the originating signal
25 detection circuit 6-4 and the selection signal reception
circuit 6-5 to the mobile communication switching system
6A and conducting control of transmission of the

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An IP address/user's telephone number stored in the IP address/telephone number conversion table in the IP address/telephone number converting circuit 10e at the provider connection interworking function device 6-2 is set by a manager of the mobile communication network who arranges the mobile communication switching system 6A.

Setting through the terminal (computer) accommodated in the Internet 9 is also possible, for example, by access to a Web page opened on the Internet 9 by the manger of the mobile communication switching system 6A. In this case, for example, a CGI program is

Although the present embodiment has been described with respect to a mobile communication network for a personal digital cellular telecommunication system (PDC) and the mobile communication terminal 3 thereof, it can be applied to other mobile phone systems. The present embodiment is applicable, for example, to a mobile phone system adopting a PIAFS (PHS Internet Access Forum Standard) in PHS.

As a result, as well as transmission from a mobile communication terminal accommodated in a mobile communication network for a personal digital cellular telecommunication system to a TCP/IP communication network which is conventionally possible, transmission from the TCP/IP communication network to the mobile

communication terminal using an IP packet is enabled to improve convenience in use.

In addition, simply adding a circuit for detecting an originating signal and a circuit for receiving a selection signal to a conventional mobile communication switching system and controlling the transmission of the circuits enables transmission to a mobile communication terminal from a TCP/IP communication network using an IP packet with ease.

Moreover, according to the method of conducting transmission from a TCP/IP communication network to a mobile communication network and the transmission and reception system therefor of the present invention, an IP address and a user's telephone number in the IP address/telephone number conversion table are set by a manager of the mobile communication network or set by a terminal accommodated in the TCP/IP communication network through the execution of a communication control protocol.

As a result, a user of the TCP/IP communication network is allowed to freely set an IP address and a user's telephone number to further improve convenience in use.

Although the invention has been illustrated and described with respect to exemplary embodiment thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions and

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additions may be made therein and thereto, without departing from the spirit and scope of the present invention. Therefore, the present invention should not be understood as limited to the specific embodiment set out above but to include all possible embodiments which can be embodied within a scope encompassed and equivalents thereof with respect to the feature set out in the appended claims.

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